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Abstract

THE PHYSICS OF A STEAM-WATER MIXTURE COOLED HEAVY-WATER POWER REACTOR

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This paper illustrates a comprehensive survey of the reactor physics work performed at C.I.S.E., within the framework of a power reactor project.

These studies were concerned with a natural uranium metal, heavy water moderated, light water-steam mixture cooled reactor, and therefore the main goals were:

(a) the assembly of a consistent set of data and theoretical models for calculating the steady-state neutron balance in such a reactor;

(b) a detailed investigation of problems of particular importance, such as neutron thermalization in the presence of two moderating media at two different temperatures and of a selective neutron absorption;

(c) the choice of convenient solutions to the flux flattening problems;

(d) the study of long-term reactivity changes.

The above-mentioned items were developed on both a theoretical and experimental basis, leading to several computing codes, to integral criticality experiments, to measurement of cell parameters and spectral indexes, to thermalization studies by means of pulsed neutron techniques.

Experimental results and calculated data are here described and compared. In particular, as regards point (a), the paper reports the results of a survey on more than 200 measured buckling relative to uranium metal-heavy water lattices; such experimental values are inserted into a code written at CISE and partial and general correlations are derived. A parallel set of measurements, performed on Aquilon II (Saclay) with fuel elements interesting this particular design is also described, together with the cell parameter measurements now in progress on a miniature assembly,

the latter involving also an experimental checking of the theoretical approaches to point (b), apart from the pulsed neutron technique.

The flux flattening problem is solved by using an inner reflector having a block body inserted into its central zone; a comparison is made with the results achieved by calculations and by experiments performed on the RB reactor (Belgrade).

On the contrary, as far as point (d) is concerned, the results reported are limited to calculations by means of a two-dimensional, two-group treatment of the isotope evolution inside the reactor.